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FOREST ECONOMICS RESEARCH AT THE ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION: A PROGRAM ANALYSIS

FOREST ECONOMICS RESEARCH

at

THE ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

(A Program Analysis)

by

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Prepared:

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Approved:

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Date

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Director

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TABLE OF CONTENTS

Page

SCOPE OF FOREST ECONOMICS RESEARCH 1

DESCRIPTION OF THE FOREST ECONOMY 3

THE REGION AS A WHOLE 3

THE HIGH MOUNTAINS 4

THE COLORADO PLATEAUS 9

THE BLACK HILLS 12

THE PLAINS 16

THE MAJOR PROBLEMS 18

FOREST LAND USE 18

Competition From Nonforest Uses 18

Competition Among Forest Uses 21

Land Ownership 23

Taxation and Regulation 23

FOREST PRODUCTION 25

Problems of Silvicultural Condition 25

Problems of Timber Management 32

Management for Uses Other Than Timber 35

Protection Problems 39

FOREST INDUSTRY 43

Problems of Industry 43

Problems of Individual Firms 47

MARKETING 54

General Marketing Problems 55

Lumber Marketing Problems 58

TABLE OF CONTENTS (CON.)

Pole and Post Marketing Problems 66

Pulp and Pulpwood Marketing Problems 68

Marketing Miscellaneous Products 69

CONSUMPTION OF FOREST PRODUCTS 71

A PROGRAM OF PROJECTS 73

BASIS FOR DETERMINING RELATIVE IMPORTANCE 73

THE PROBLEMS NOW BEING STUDIED 74

PROPOSED PROJECTS AND PRIORITIES 77

Projects Leading to Increased Resource Use 78

Economic Problems in Forest Land Management 81

Problems of Measuring Multiple Use Benefits 84

BIBLIOGRAPHY 86

LIST OF TABLES

Table No.	Title	Page
1.	Land area of the region, by major classes of land and by section	19
2.	Significant areas of commercial forest land shifted to other use	20
3.	Average size of private commercial forest land ownership and percent over 500 acres for selected states	24
4.	Comparison of net annual growth with timber cut from growing stock	27
5.	Comparison of net annual growth with timber cut from live sawtimber	27
6.	Commercial forest land area by stand-size class, 1952	28
7.	Commercial forest land area by selected stand-size classes by degree of stocking, 1952	30
8.	Annual mortality of live sawtimber and growing stock on commercial forest land by cause, 1952	40
9.	Estimated production of primary wood products in region in percent of total, 1955	59
10.	Partial number of sawmills by type and capacity, 1955	62

A PROGRAM ANALYSIS FOR FOREST ECONOMICS RESEARCH at THE ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

by

Carl A. Newport

SCOPE OF FOREST ECONOMICS RESEARCH

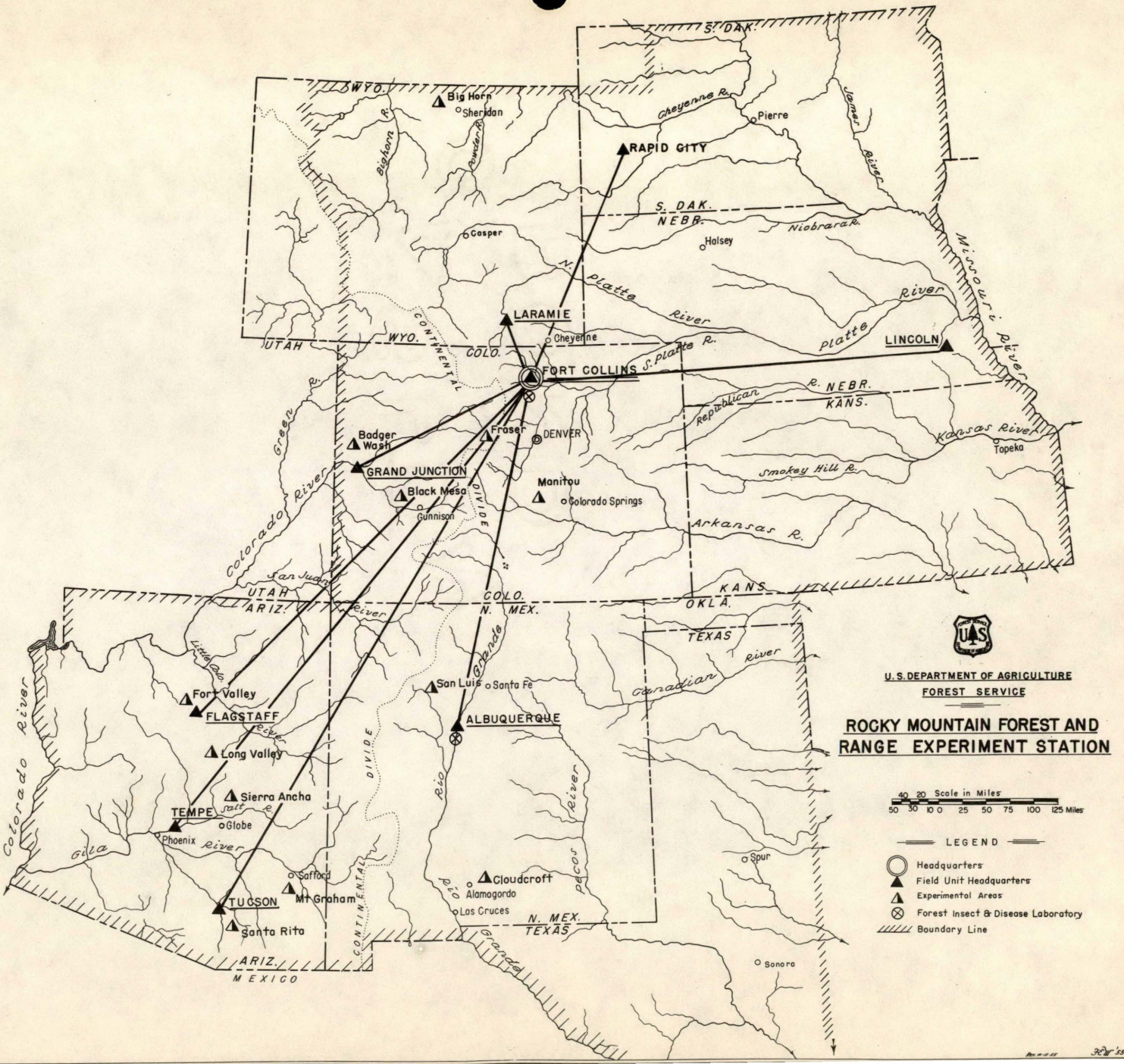
Forest economics has been considered to cover "the entire range of economic and social problems involved in the production and utilization of forest resources, including all of the various commodities derived from forest land and all of the services rendered by forests" (22, p. 4). Duerr and Vaux state that "the subject matter of forest economics ---- embraces any information which should be considered in determining how to use forest resources and how to combine them with nonforest resources in order to maximize the total net returns obtainable from the economy" (10, p. 16).

Both of these definitions stress the point that forest economics is oriented to all the problems of forest resource use. Some of these problems may be far removed from the forest, such as the problem of pulp marketing in large industrial areas and its influence upon economic development based on local pulpwood resources. Some of the economic problems may be intricately related to technical problems being studied primarily under the headings of forest management, range management, watershed management, recreation, protection, or wood utilization. For

example, the problem of marketing pulp is closely integrated with the technical problem of producing chemical pulp on a small production basis from local species.

Since forest economics has such a broad scope and enters into the solution of all of the forester's practical problems, it is necessary that a program for research in this field be based upon two approaches. First, it must be correlated with the technical research planned in the other divisions and field units. Second, it must be designed to investigate the economic aspects of those problems that are currently faced by land managers and forest users. These latter problems will generally originate from public and private forest land managers and private forest industries.

Although the two approaches are made in considering this program of research, the presentation of the problems will be according to five main branches: forest land uses, forest production, industry, distribution, and consumption. Before the subject matter breakdown of economic problems is made, the general characteristics of the study area must be reviewed.


S. DAK.
WYO.
Big Horn
Sheridan
Bighorn R.
Powder R.
Cheyenne R.
Pierre
Joner River
RAPID CITY
S. DAK.
NEBR.
Niobrara R.
Halsey
Missouri River
Casper
N. platte River
LARAMIE
Cheyenne
UTAH
WYO.
COLO.
CONTINENTAL DIVIDE
FORT COLLINS
S. platte R.
platte River
LINCOLN
Green R.
Republican R.
NEBR.
KANS.
Badger Wash
Fraser
DENVER
Kansas River
Topeka
GRAND JUNCTION
Smokey Hill R.
Black Mesa
Gunnison
Manitou
Colorado Springs
Colorado River
Arkansas R.
San Juan River
UTAH
ARIZ.
COLO.
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OKLA.
TEXAS
Canadian River
Rio Grande
San Luis
Santa Fe
Fort Valley
FLAGSTAFF
ALBUQUERQUE
Long Valley
Sierra Ancha
TEMPE
Salt R.
Globe
Phoenix
Gila River
Pecos River
Spur
Safford
Cloudcroft
Alamogordo
Mt Graham
TUCSON
Las Cruces
Santa Rita
N. MEX.
TEXAS
ARIZ.
MEXICO
Sonora
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION
40 20 Scale in Miles
50 30 10 0 25 50 75 100 125 Miles
LEGEND
Headquarters
Field Unit Headquarters
Experimental Areas
Forest Insect & Disease Laboratory
Boundary Line

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DESCRIPTION OF THE FOREST ECONOMY

THE REGION AS A WHOLE

The region with which this program analysis is concerned consists of the 7 states of Arizona, Colorado, Kansas, Nebraska, New Mexico, South Dakota, and Wyoming. This is simply a region whose research needs are served by the Rocky Mountain Forest and Range Experiment Station. It is not necessarily one of uniform economic, physiographic or forest conditions. On the contrary, it is characterized by a wide diversity of conditions. The physiography ranges from plains to high rugged mountains. The vegetation ranges from wooded streambottoms, through prairie grassland, foothill brushland, montane forest, to subalpine forest and grass. The culture varies from the rugged individualism of the ranchers and farmers to the trade and manufacturing industrialism of such metropolitan areas as Denver and Omaha. Racially, also, there are great differences. Indians, principally on reservations, are found in all of the states of the region. Spanish-Americans predominate in many localities of Colorado, New Mexico, and Arizona. Essentially rural and agricultural, the region nevertheless supports numerous industries upon its vast deposits of oil, coal, uranium, and other minerals and has also developed important industries based on the processing of agricultural and mineral products.

In order to facilitate an analysis of the problems of this diverse region, it is necessary to first divide it into smaller,

more uniform areas. There are four areas:

1. The High Mountains - more specifically the lodgepole pine and spruce-fir area of central and northern Colorado and Wyoming.
2. The Colorado Plateaus - more specifically the ponderosa pine area of southern Colorado, Arizona and New Mexico.
3. The Black Hills - more specifically the ponderosa pine area of eastern Wyoming and western South Dakota.
4. The Plains - more specifically the Nebraska, Kansas, and eastern South Dakota area.

These subdivisions are believed to conform in general to the broad geographic pattern of forestry conditions in the region and will be used later in describing and analyzing these conditions.

THE HIGH MOUNTAINS

The high mountains area is comprised of central and northern Colorado and Wyoming. It is characterized by the large proportion of the area which is above 7000 feet elevation. All of Wyoming and two-thirds of Colorado make up a total land area of about 95 million acres.

Physiography

The high mountain area as defined here is not all mountains, but its mountainous parts are so predominant and so closely related to the nonmountainous parts that it must be considered as a unit.

The mountain ranges are, for the most part, linear north-south crests resting on structural uplifts and are generally flanked by outward-dipping strata making hogback foothills. The Wyoming Basin of central Wyoming is a high plateau which nearly separates the southern Rocky Mountains of Colorado from the mountains in the Yellowstone region. The isolated hills and mountains seen in the Wyoming Basin are the tops of partly buried structures which connect the northern and southern ranges of this area. However, this hidden connection happens to be an area where the general direction of the crests swings to the west so that the northern ranges are much offset to the west even though their crests lie in the same north-south direction as the southern ranges.

Since the continental divide follows the crest of this high mountain area, the major rivers of America have part of their origin here. The Yellowstone, Platte, and Arkansas Rivers have their headwaters in the north and east portions of the area and drain into the Mississippi. The Rio Grande River has its headwaters in the southern part of the area. These rivers compose the main Atlantic side of the continental divide. On the Pacific side the Colorado River drains the major part of the western half of this area. The Snake River drainage reaches into the area in the Yellowstone region of northwestern Wyoming and drains into the Pacific Ocean via the Columbia River.

The soils of the area show great differences from one locality to the next. The most limiting factors in determining

vegetation patterns and agricultural use of the land seem to be moisture and elevation.

Agriculture

The agriculture of the area is of three major types: grazing, special irrigated crops, and dryland farming. The grazing utilizes the high plains and mountain meadows to raise sheep and cattle. Important irrigated crops are hay, sugar beets, potatoes, and corn. Dryland farming produce is principally wheat, corn, and hay. About one-half of the total number of farms are livestock ranches. More than 85 percent of the farms are 1000 acres or more in size. Three-fourths of the number of farms, as well as of the farmland area, are operated by either full or part owners (27). In general, the area is one of large ranches owned and operated by rugged individualists. However, there is a definite increase in the production of irrigated crops on smaller farms as river basin developments are expanded.

Industry

The industry of this high mountain area is concentrated in a strip extending down the eastern base of the mountains from Casper on the north to Pueblo on the south. Eleven of the fifteen cities in the high mountain area with populations over 10,000 are located in this industrial belt (28). About 70 percent of the population of the high mountain area is here. This is the outstanding industrial

area of the entire region served by the research station. It contains the two metropolitan areas of Denver and Pueblo. Petroleum, meat, metal, stone, and chemical products are manufactured here. In addition, the area is important in mining, printing and publishing, sugar production, wood products, and as an air, rail, and truck transportation center. The natural scenic wonders of the high mountain area has also given rise to what is locally known as the "tourist industry". Raw materials for this industrial area are the products of the outlying areas: oil, iron, coal, sheep, cattle, beets, minerals, and trees.

The Forests

Twenty-two percent of the total area of the high mountains is forested. These forests cover the mountain slopes from about 6000 feet elevation upward. Only about 9 percent of the total land area is considered to be in commercial forest. Eighty percent of the commercial forest area is in federal ownership, 72 percent in National Forests (26).

The principal commercial cover types are the lodgepole pine and the Engelmann spruce. Other types found in lesser amounts are alpine and corkbark fir, ponderosa pine, aspen, and Douglas-fir. These occur in pure stands as well as in mixture. The higher elevations are occupied principally by Engelmann spruce, alpine and corkbark fir. These stands are generally virgin, overmature and average about 3.5 M board feet per acre in live sawtimber (26).

The greatest amount of cutting in this type has been a result of the need to harvest the bug-killed timber in Colorado. At somewhat the same elevation and slightly lower, depending on site conditions, are located extensive pure stands of lodgepole pine. Some of this type is densely covered with old overcrowded trees of submerchantable size as a result of past fires. The average volume of live sawtimber per acre is 2.76 M board feet per acre (26). The cutting dates back to the coming of the railroad and has been relatively light and scattered. Generally below and mixed in with the two types just described are the other species. Of these, ponderosa pine has probably experienced the most use. It is located at the lower, more accessible elevations along the Front Range in Colorado and Wyoming and was utilized rather heavily in the early development of the region, even though the stands were light and scattered and the trees were rough and small. The average volume per acre is probably much less than 2 M board feet per acre. Due to the overmaturity of the spruce, the density of the lodgepole pine, and the light stands of ponderosa pine the average sawtimber growth per acre is about 50 board feet per year.

Outlook for the Economy

The high mountain area is relatively young and undeveloped industrially and agriculturally. Industry has expanded rapidly in recent years and is becoming more powerful, economically and politically, than the grazing and mining interests which have predominated the scene in the past. However, agriculture is growing in the

field of irrigated crops as the upper river basin projects increase and redistribute the available water. Competition for water between industry, agriculture, and domestic use will be one of the most important determinants of the future of the area.

THE COLORADO PLATEAUS

Although the Colorado plateaus extend over a much wider area geologically, it will be limted herein to include only southwestern Colorado, Arizona, and New Mexico. From the standpoint of settlement and civilization, this area is the oldest of all the region covered by the research program. In fact, this area has revealed relics of the oldest habitation in North America. Southern Arizona and New Mexico are not considered a part of the Colorado plateaus geologically, but for purposes of this program analysis it will be included.

Physiography

The Colorado plateaus are similar to the high mountains in their great elevation. Aside from the canyon bottoms, only a small portion is lower than 5000 feet. It differs from the high mountains in that it is made up of essentially horizontal rock strata rather than folded. The many steep slopes that do occur are the result of erosion. Except where bordered by the high mountains of Colorado, the plateaus overlook the neighboring areas from a bold escarpment on the south. This escarpment breaks off into the Salt and Gila

River Basin on the southwest. The Colorado River flows through the plateau area and its tributaries, the San Juan and Little Colorado drain into it along the way. The entire plateaus are distinguished by the hundreds of remarkable canyons, the Grand Canyon being the most familiar. The total land area of Arizona, New Mexico, and southwestern Colorado is about 170 million acres.

Rural Life and Agriculture

In order of their importance in terms of land area, the uses are grazing, irrigated crops, and dryland farming. The acreage of land in farms of 1000 acres or more makes up 95 percent of the total farm acreage and almost all of this is grazing land. The value of the products sold from sheep and livestock ranches is over 25 percent of the value of all agricultural products sold. Irrigated croplands produce cotton, vegetables, hay, sorghum, and barley in about that order of importance. Only 3 percent of the farmland is irrigated but this produces the major part of the total value of agricultural crops sold. Less than 1 percent of the farm acreage is in dryland crops (27). In this area, as in the high mountains, large ranches have predominated for many years, but irrigated crops are increasing in importance. The production of long staple cotton and vegetables is the most important. This has resulted in considerable concern on the part of the water users about the yields of water from the high mountain area to the north and from their own plateau country.

Industrial Development

There are only 10 cities in this area with 10,000 or more inhabitants and 7 of these are under 30,000 population. Phoenix, Tucson, and Albuquerque are the largest metropolitan areas, yet none of these is what could be called a large industrial center (28). Mining and chemical processing is probably the most important industry group outside of those activities such as food processing and printing which are local service industries. Lumbering and wood products manufacture accounts for slightly less than 10 percent of the total value added by manufacture. The warm, arid climate has resulted in a large tourist business in the southern portion during the winter months. The scenic wonders of the high plateaus also draw a large number of tourists during the summer. Existing and proposed water developments provide more water for domestic and irrigation use and power for domestic and industrial use.

The Forests

Of the total of about 47 million acres of forest covered land, only 8 million acres are in the interior ponderosa pine type. However, in terms of volume, value, and growth it is the most important type. About one-third of the area of the ponderosa pine type is at present commercially inaccessible or withdrawn from use for other reasons. Logging has been carried on in the past on about one-half of the accessible land. The stands are light as compared

to the forests of more humid regions, ranging from 5000 to 15000 board feet per acre. Growth per acre per year is about 60 board feet. However, it is believed that improved management can easily double or triple this figure (20).

Other species found in Arizona and New Mexico that are harvested commercially in minor amounts are Douglas-fir and the true firs.

The Future

Although this area is the oldest in terms of civilization, it is probably the youngest in terms of industrial development. Arizona and New Mexico did not obtain statehood until 1912. Population and industrial growth has been very rapid in recent years. All appearances indicate that this growth will continue. Industry and irrigated agriculture have primarily developed as a result of desire to be near raw materials and land. However, population growth in the area will undoubtedly result in greater development to supply increasing local needs. The forest resource is capable of supporting an expanded industry, both horizontally and vertically greater. Such expansion is already in progress.

THE BLACK HILLS

This is the most unique area in the Rocky Mountain region. It is a relatively small area in western South Dakota and northeastern Wyoming. The distinction as a separate area for this analysis is made because of its importance in the forest economy of the

whole region.

Geology and Soils

The Black Hills rise several thousand feet above the level of the surrounding plains. They have abundant rainfall in comparison to the plains and as a result are covered with timber and numerous streams. Geologically, they originated from a domeshaped uplift which has since eroded, exposing some sedimentary rocks that are older than the upper layers of the surrounding plains. The Black Hills are about 100 miles in north and south length and about 50 miles wide. The soils are of residual origin except in the valley floors and the depth varies considerably, depending upon the rate of erosion. The most fertile soils are derived from the limestone rock and these support most of the best tree growth.

Agriculture

Only about 60 percent of the land in the Black Hills is in farms while the plains area is about 90 percent farm land. The remainder is in mining industry and government ownership. Grazing is the most important use, occupying over 80 percent of the farmland area and producing over 80 percent of the value of farm products sold. Less than 10 percent of the farmland area is in crops. About 10 percent is in woodland, part of which is grazed (27). The farms are generally centered in the parks and open valleys in and around

the hills. For the most part, they are made up of original homesteads obtained under the Forest Homestead Act of June 11, 1906.

The Mining Industry

The principal industrial activity in the Black Hills is mining and mineral processing. The Homestake Mining Company operates the largest gold mine in the United States at Lead in the northern hills. There is much uranium mining activity in the southern hills. The state of South Dakota operates a cement factory in Rapid City which is the only city in the hills of over 10,000 population. Lumbering is the next most important industry. There are about 50 sawmills operating in the Black Hills and most of these are of the small circular type. Although the sawmills are scattered throughout the hills, most of the other industry is concentrated in the Lead, Deadwood, and Rapid City areas. One other important part of the economy of the Black Hills is the tourist business. Custer is said to have visits from over one and one-half million tourists each summer.

The Timber Resources

There are 2 million acres of forest land in the Black Hills area. About 88 percent of it is commercial forest land. About three-quarters of it is publicly owned, mostly National Forest. Ponderosa pine predominates the entire Black Hills. There are small, scattered patches of eastern white spruce, aspen, and birch that are of little or no commercial importance. Cutting in the pine stands has been

going on since white men first settled in the hills in the 1870's. There are only a few virgin areas remaining. Almost all of the timberland, public and large private, is under forest management.

The average annual sawtimber growth is about 50 to 100 board feet per acre. The total estimated allowable cut is over 60 million board feet per year.

Most of this is cut and converted into lumber and 70 percent of the lumber production takes place in 18 of the 50 sawmills. Other products include posts, poles, and small amounts of pulpwood. The national forest land has the distinction of being under management longer than any other in the nation. The first timber sale from a national forest was made in 1898 to the Homestake Mining Company (19).

Reproduction occurs abundantly in the cutover stands and this results in crowded stands of small poles. Fire protection has progressed rapidly under the increasing intensity of management. Thinning in immature stands was started during the CCC days of the 1930's. Today it is continued on a rather large scale through the collection of Knudsen-Vandenberg funds from timber sales on the national forest.

The Future

There are indications that the future will bring an expansion in industries in the secondary manufacturing of wood products. Recently, there has developed a firm making prefabricated houses and another making wooden toys. It is also expected that a local pulp industry will be established as a result of the availability of raw

material in immature stands and of the continued nationwide heavy use of paper and paper products. Population of the area itself is not increasing very rapidly. Therefore, further industrial developments will result from a need to be near raw materials to supply the needs of population centers to the east and south of the Black Hills rather than to supply local markets within the hills.

THE PLAINS

From a forest economy viewpoint the plains area is more important as a consumer than as a producer. Geographically, it is all of Nebraska and Kansas and those parts of Wyoming, South Dakota, and Colorado exclusive of the high mountains and Black Hills areas. However, the only portion that deserves attention as productive forest is that in Kansas, Nebraska and eastern South Dakota. The forest is principally the streambottom hardwood type and is estimated to be about three or four million acres in extent. The principal species are cottonwood, box elder, willow, elm, and ash. Two other types exist. They are the shelterbelt plantings and the ponderosa pine bluffs. Most of the use of these plains types is domestic in the form of fenceposts and fuel for farms and ranches.

The population of the plains area increases in density from west to east (from higher plains to Missouri River). There are 40 cities of over 10,000 population and most of these are concentrated near the Missouri River (28). This constitutes an important wood products consuming area. As such, it is more important to the forest

economy of the high mountains, plateaus, and Black Hills areas than to its own scattered forest. It is a market that will continue to be the scene of competition between the wood products of the South, the Pacific Coast, and the area considered in this analysis.

THE MAJOR PROBLEMS

This brief background of the area should suffice to permit a detailed discussion of the economic problems of forestry in the area of the research station. The approach will be on the basis of subject matter rather than area. The 5 subject matter divisions will be forest land use, forest production, forest industry, distribution, and consumption. The problems of each will be discussed and related to specific forest areas and to other phases of research.

FOREST LAND USE

Competition of Nonforest Uses for Forest Land

The problems of forest land use in the Rocky Mountain region are not as complicated as those in other forest regions of U. S. because of the preponderance of federal ownership. Almost 70 percent of the commercial forest land is publicly owned. Most of this is in national forests which are dedicated to the production of all the goods and services that forest land is capable of producing. Table 1 shows the major classes of land by sections of the research region. Table 2 indicates a few of the conflicts between forest and nonforest uses. Water developments sometimes conflict. Although one forest use is the production of water, the facilities for storage and transportation of water sometimes compete for the use of forest land. This problem will need more study as water diversion, storage, and transportation for population centers is expanded.

Mining activity is competing for the use of forest land in

Table 1 -- Land area of the region, by major classes of land, and by section, January 1, 1953 1/

	High Mountains	Colorado Plateaus	Black Hills	Plains	Total Region
	- - - - - - - - - - - - - Thousand Acres - - - - - - - - - - - - -				
Forest land	31,347	40,541	1,393	3,926	77,207
Commercial	11,926	8,915	1,266	3,828	25,935
Noncommercial	19,421	31,626	127	98	51,272
Productive but reserved	2,502	840	15	9	3,366
Nonproductive 2/	16,919	30,786	112	89	47,906
Reserved	1,602	920	18	--	2,540
Unreserved	15,317	29,866	94	89	45,366
Cropland in farms	13,740	3,475	818	69,300	87,333
Pasture and range 3/	80,991	98,398	4,321	69,151	252,861
In farms	48,146	67,994	3,321	53,299	172,760
Not in farms	32,845	30,404	1,000	15,852	80,101
Other 4/	2,836	8,041	87	1,600	12,564
Total land area	128,914	150,455	6,619	143,977	429,965

1/ Source: TRR, Vol. IX pp. 1-2

2/ Lands currently unproductive for timber, but includes land that may be currently productive for the management of grazing, watershed, recreation, or wildlife resources.

3/ Exclusive of that in forest land.

4/ Farmsteads, roads, powerlines, urban, etc.

Table 2 -- Significant areas of commercial forest land shifted to other use (except cultivation and pasture use) between 1945 and 1953 1/

Name of Area	Area Shifted to: Recreational Use 2/	Water Use 3/	Other Use 4/	Total
	Acres	Acres	Acres	Acres
High Mountains	1,800	26,700	2,000	30,500
Black Hills	900	1,400	0	2,300

1/ Source: U.S.F.S. Region 2, TM 55-29, October 27, 1955, pp. 3
2/ Includes all areas withdrawn from other forest uses
3/ Includes reserved watersheds and reservoir areas
4/ Includes urban and right of way uses

some areas. The actual mining, as such, is generally conceded to be a use that is higher than the forest uses. However, exploration and claim establishment conflicts by tying up forest land in non-use for extended periods of time. Some improvement is being made in this situation through changes in mining laws. Actual commercial mining has been found to provide higher returns to the economy than the generally slow-growth timber production of the same area. This will probably continue to be the case for some time to come. Recreation and water production are becoming increasingly valuable uses of the forest. When mining activity competes with these, problems arise that need study. Part of the decision regarding the land use must be based upon economic analysis of the cost-benefits type. However, such cost-benefits analysis will have to await further research in the biological aspects of the production of timber, range, water, and recreational goods and services.

Competition Among the Forest Uses of Forest Land

Timber, range, water, wildlife, and recreation are the principal forest uses. Competition among these uses can be called a problem of multiple use. All trends seem to indicate that there will be an increasing pressure for the production of the goods and services provided by each of these uses. Recreational use of the national forests increased by 67 percent from 1950 to 1955 (25). This use extends to other public and private forest lands at about the same magnitude. The production of lumber increased by about

60 percent in the study area from 1944 to 1954. Range, water, and wildlife use intensity depends, to a great extent, upon population. Population in the study area has increased by about 13 percent in the decade prior to 1950. A maximum increase of 50 percent was experienced in Arizona. This continued increase in the demands upon the forest land makes it more imperative that forest land managers obtain biological and economic information on the relationships between the several uses, singly, and in combination. Since most of the forest land involved is in public ownership, decisions made as to what use or combination of uses should be applied will have to be made using both economic and social criteria. The objective is maximization of total net return in economic and social benefits. The problem of the right combination cannot be decided by economic criteria alone. However, action should be taken toward the development of sound economic criteria to be used in conjunction with social measures of cost and benefit. If the land managers do not develop such economic criteria, they may find that special interests, i.e., water users, may come up with their own methods of economic evaluation. Their methods may be unsound, improperly directed, or even biased in their favor. Forest economics research must keep in close touch with the biological research of other divisions with a view to establishing usable measures of economic costs and returns of various forest land management proposals. Equally as important, they must keep in touch with the trends in the demand for the goods and services provided by the forest land, for these trends will reveal much regarding the relative value of the

benefits of the various uses. This will be further elaborated under problems of management for other uses.

Land Ownership

Due to the fact that most of the forest land in the station territory is publicly owned, there are only a few problems of tenure. This makes the area unlike many other forested areas of the nation where small private land ownership and management is a major forest problem. In this area only 30 percent of the commercial forest land is privately owned. The average size of ownership in the states of the study area are indicated in Table 3.

The problems of private forestry are most directly related to size of ownership and to type of tenure. In the study area the plains section would seem from Table 3 to have problems due to the small size of ownership.

Problems arising from the type of tenure generally are associated with tenant farmers and with frequent changes of ownership. Although no data is available these latter two conditions are much less common in the study area than in most other parts of the nation. Again, any such problems that exist are concentrated in the private ownerships of the plains portion of the area. Other problems of private ownership will be considered under the subject of marketing.

Taxation and Regulation

Only one of the states has special forest tax legislation and it is entirely ineffective. The private forest land in all

Table 3 -- Average size of private commercial forest land ownership and percent over 500 acres for selected states 1/

State	Average Ownership	500 Acres and Larger
	Acres	Percent of Total Area
Arizona	273	73
Colorado	372	63
Kansas	29	0
Nebraska	26	0
New Mexico	851	85
South Dakota	33	9
Wyoming	514	78
Station Area	55	30

1/ Source: TRR, Vol. IX, p. 7

states of the territory is taxed under the ad valorem property tax. No progress has been made toward providing for equitable application of the tax to timber and land in any of the states. However, there is very little indication that the tax is a burden on forest land. Generally, timberland is considered to be of little value, even when mature, and valuation for tax purposes is low. In some instances the property tax classification, "forest land", carries a high valuation. In these cases it is frequently found that such classification is avoided by calling it "waste" or "range" on tax rolls, since these latter classes have lower valuations. As is the case elsewhere, a general overhaul of the property tax laws and their administration would do much to eliminate the problems that do exist in forest land taxation. None of the states have any regulatory laws regarding slash disposal or provision for reproduction. The public lands do not need such legislation and private lands are a less important part of the forest economy. Therefore, regulation is not considered to be a problem.

FOREST PRODUCTION

Problems of Silvicultural Condition of the Forest

Growth and Cut

The station territory is characterized by the excess of growth over timber cut. Net annual growth exceeds timber cut from growing stock by almost three-fold (table 4). It exceeds timber cut from

live sawtimber by about 1.7 times (table 5). The most plausible explanation of this condition is that this area and its sawtimber are less accessible and less desirable than that of other forested regions. Consequently, pressures toward overcutting have generally been lacking. Furthermore, where local demands for standing timber have been strong, federal ownership and management has prevented overcutting. On some of this federal forest land, conservative estimates of growth may have resulted in undercutting, even though some demand was unsatisfied. Two lines of action are indicated by the conditions. First, better information on growth and volume is needed. Forest Survey is working on this problem over much of the area now. Secondly, action is needed in the field of marketing and utilization in order to stimulate increased harvesting. This aspect of the problem will be discussed later.

Age Class Distribution

The distribution of age classes is as one would expect in a relatively undeveloped forest region (table 6). For the whole territory 54 percent of the commercial forest area is in sawtimber stands and over half of that is old-growth. In the Black Hills where management and cutting have been in effect for 60 years, less than one-quarter of the sawtimber stands is old-growth. The major problem area in this respect is the Colorado plateau. Here 76 percent of the stands is of sawtimber size and only 3 percent is seedling and sapling size. This is even more significant when it is noted that

Table 4 -- Comparison of net annual growth with timber cut from growing stock on commercial forests, 1952 1/

Area	Net Annual Growth	Timber Cut From Growing Stock	Relation of Growth To Timber Cut
	Million cu. ft.	Million cu. ft.	Percent
High Mountains	161	45.6	353
Colorado Plateaus	99	60.3	164
Black Hills	26	8.5	306
Plains	79	10.9	725
Total	365	125.3	291

1/ Source: TRR, Vol. IX, pp. 22-29

Table 5 -- Comparison of net annual growth with timber cut from live sawtimber on commercial forests, 1952 1/

Area	Net Annual Growth	Timber Cut From Live Sawtimber	Relation of Growth To Timber Cut
	Million bd. ft.	Million bd. ft.	Percent
High Mountains	328	215.2	152
Colorado Plateaus	445	368.5	120
Black Hills	61	40.8	150
Plains	288	39.4	731
Total	1122	663.9	169

1/ Source: TRR, Vol. IX, pp. 22-29

Table 6 -- Commercial forest land area by stand-size class, 1952 1/

Name of Area	Total	Sawtimber Stands			Pole-Timber	Seedling and Sapling	Nonstocked and Other
		Total	Old-Growth	Young Growth			
High Mountains							
percent	100	47	35	12	28	18	7
area - thousand acres	11,926	5,606	4,123	1,483	3,323	2,146	851
Colorado Plateaus							
percent	100	76	45	31	16	3	5
area - thousand acres	8,915	6,754	3,970	2,784	1,424	248	489
Black Hills							
percent	100	52	14	38	23	20	5
area - thousand acres	1,266	655	174	481	297	253	61
Plains							
percent	100	28	1	27	36	20	16
area - thousand acres	3,828	1,089	25	1,064	1,362	760	617
Total							
percent	100	54	32	22	25	13	8
area - thousand acres	25,935	14,104	8,292	5,812	6,406	3,407	2,018

1/ Source: TRR, Vol. IX, pp. 3-4

this area has over one-third of the commercial forest land area. The 16 percent of nonstocked area in the plains represents a problem. This area is located near consuming centers and probably represents potentially good producing sites for hardwoods, yet is contributing nothing to timber supply.

The existence of public forest management and an increasing demand for wood products will probably do much to correct the excess of sawtimber-size stands. The problems of nonstocked areas and of inadequate seedling and sapling areas will need attention. These problems are found on both public and private lands but those on private lands will probably need the greatest attention.

Condition of Stocking

Sufficient data are not available on which to base an analysis of the degree of stocking. Indications are that about one-quarter to one-third of the young growth stands have stocking of less than 40 percent of full stocking (table 7). This is a serious problem. However, one that is probably more serious is the problem of overstocking in the lodgepole pine stands of the high mountains and in the ponderosa pine stands of the Black Hills. The loss of growth due to crowding and stagnation can be great on these areas.

The problem of understocking should be attacked on the seedling and sapling size areas. This resolves itself into a problem of regeneration and will be discussed later. The problem

Table 7 -- Commercial forest area of selected stand-size classes by degree of stocking, 1952 1/

Name of Area 2/	Young-growth Sawtimber Stands		Pole Timber Stands		Seedling and Sapling Stands	
	Well and Medium Stocked	Poorly Stocked	Well and Medium Stocked	Poorly Stocked	Well and Medium Stocked	Poorly Stocked
High Mountains						
area - thousand acres	1,048	436	1,581	742	1,634	512
percent	71	29	68	32	76	24
Black Hills						
area - thousand acres	371	110	211	86	175	78
percent	77	23	71	29	69	31

1/ Source: U.S.F.S. - Region 2, TM 55-29, October 27, 1955. p. 3
2/ No information available for Colorado Plateaus and Plains

of overstocking is one to be solved principally by thinning. Work is needed on better thinning methods and upon markets for small material from thinned stands.

Economic Significance of Stand Conditions

Whether or not the present condition of the forests in the study area is a serious economic problem depends upon what one considers to be optimum conditions for the future. For example, the existence of overstocking in pole-size stands is quite serious in a sawtimber economy but much less so in a pulpwood economy. Only if there is an established goal of forest conditions for the future, can the present silvicultural condition be analyzed as a principal problem needing solution. This problem analysis could, but will not, be concerned with the establishment of goals for future forest conditions. The forest land owners and managers are currently operating under some plan of either long or short term nature. This problem analysis needs to be concerned with the difficulties in timber management now being encountered under these plans. For example, assuming the goal in the Black Hills is sawtimber production, is the method of treating overcrowded stands economically justified and, if not, can methods be devised that are economically sound? The next section will approach timber management with the aim of defining problems of this nature.

Problems of Timber Management

Unsatisfactory Regeneration

The lack of or inadequate regeneration may result from several conditions. The two situations in this study area that are of most concern are those resulting in unsatisfactory regeneration due to fire and insect damage and due to poor site and seeding conditions. A current problem exists in the extensive insect-killed areas of Engelmann spruce in the high mountains section. As technology finds successful methods of artifical regeneration, studies will be necessary to determine the most economical method. Some consideration of the objective of management may be necessary to find the solution to this problem. The most desirable species composition must be determined in light of the expected future needs of wood products industries.

Another regeneration problem is that found in the ponderosa pine stands of the Southwest. Some partially cut stands are not reproducing themselves satisfactorily and there is a noticeable absence of the youngest age-classes on managed forest lands. This may mean that artificial regeneration will be needed. Decisions must be made as to whether action needs to be taken to reproduce these stands and, if so, what type of action.

Thinning and Pruning

The possibilities for increased growth as a result of thinning have received attention in the station territory for many years. The principal species that apparently need to be thinned are ponderosa pine and lodgepole pine. Both these species tend to become overstocked and even stagnant. The technology of thinning is currently a subject of investigation. The economic advisability of it has received little or no attention. The national forest collections, in Region 2 alone, of funds for timber stand improvement have increased from $191,262 in 1953 to $697,056 in 1956. Region 3 of U. S. Forest Service collects as much or more. Some reliable data is now available on the increased yields for different intensities of thinning and more is being collected. The time seems to be appropriate for economic studies of thinning. The federal program of payments to private land owners for timber stand improvement work done gives further emphasis to the need for economic studies. Studies of the costs and benefits of thinning may make it necessary to reconsider the growth of sawtimber as the proper goal of most of the timber management in the region.

Pruning is similar in nature to thinning and also will need economic studies. However, at this time only very little is known regarding the technical aspects of improved quality through pruning.

Timber Appraisal

The disposal of mature timber from publicly-owned forests in the station territory involves over 8000 sales for which appraisals must be made. The value of the timber sold in these commercial transactions is about $3,500,000 annually. The number of transactions and volume involved will continue to increase. Timber appraisal techniques have been recently revised and will need continued review as timber conditions, methods, and markets change. Furthermore, care needs to be taken to assure that the application of the standard appraisal techniques are made with the proper valuation principles in mind and with the best available cost and value data. Economics research will be needed on a continuing basis.

Financial Maturity and Optimum Stocking

The Black Hills is the only area in the territory which has its forest sufficiently regulated and silviculturally controlled to warrant studies of the economic aspects of rotation and cutting cycle length. At present the cutting cycle is based primarily upon board foot increment which is, in turn, a function of physical vigor. Little consideration has been given to the influence of harvesting costs and quality increment upon the length of cutting cycle. This is a subject of study which should warrant consideration very soon. Such information would assist the forest managers immeasurably in

making decisions and in defending existing policy. Studies of log-grade lumber recovery have been made and these provide a basis for attacking the problems of financial maturity and optimum stocking. These studies should be continued with this purpose in mind.

Problems of Management for Uses Other Than Timber

The publicly-owned forest lands are dedicated to the production of the greatest good to the greatest number. This is here interpreted to mean that each acre must produce the single good or service, or combination, that produces the maximum net return to the economy and society. Net return is total benefit less all costs. Benefits and costs can only be brought into relationship with each other through a common denominator. In our economy this denominator is found in money. Hence, a treatment of production that takes account only of physical output and physical input is incomplete. The money revenue from output and the money cost incurred for input have to be related to each other. This is not to say that there are no other common denominators nor that other bases for decision-making should be ruled out. The position of economics research in forest management should be considered as that of any other tool for measuring and interpreting relationships as a basis for decision-making. The decision-making job itself falls on the land manager.

In considering the several uses of the forest, the manager generally finds that more than one can be produced at a time.

He also finds that, as the intensity of management increases, it is easier to determine the optimum level of inputs if only one product is produced. When two or more products are desirable, how much effort should be expended toward each is more difficult to determine. In economics this is a problem of joint production analysis. Due to the physical relationships between the goods and services produced by forest land, most of the forest land use problems are problems of joint production. Timber production results in the production of some water and some game, even without effort in that direction. When the other uses increase in value relative to timber, more effort in their production is justified. Economical analysis of multiple products from the forest must await further study of physical input-output data for various combinations of inputs for the production of the several goods and services. Some physical data is now available on the production from single uses other than timber and on combinations of one of these other uses with timber. Further problem discussion will be limited to these conditions where physical input and output data are available.

Watershed Management

The demands of industries, cities, and agriculture continue to increase in the station territory (3,8). Research in watershed management continues to provide physical data on water production under various types of watershed treatment. This information is vitally needed now to direct the efforts of public forest land

managers. Sufficient physical data are now available to warrant the beginning of studies to appraise the costs of alternative programs of public investment in watershed improvement; to evaluate the individual and social benefits accruing; and to determine what watershed improvement measures are justified. Such economic studies involve an evaluation of the uses of nonforest land. Therefore, the best approach would be one made cooperatively with state experiment station staffs of agricultural economists and irrigation engineers. The study should include the effects of the watershed program upon the other uses of the forested watershed in order to estimate what levels of conflicting use are economically justifiable. The recent Barr Report has made it clear that the approach to this problem must be made by technologists and economists as a cooperating group and with complete understanding of the objectives of economic analysis (3).

Range Management

There are two types of relationships between range and timber use which need economic evaluation. In certain circumstances the uses are mutually exclusive. If timber is grown, there can be no grazing, and vice versa. The clearing of lodgepole pine to increase pasturage is an example of a problem where the uses are mutually exclusive. In other circumstances the uses may be compatible or only conflicting in the extreme. Grazing in ponderosa pine stands of the Southwest and Black Hills are examples.

The first of these circumstances is not important in terms of land area at the present. Most of the land clearing for grazing use is on the noncommercial forest land. However, studies are needed on the costs and returns of land clearing methods used to extend grazing areas. These practices are the subject of range management research on mesquite and chaparral lands in the Southwest and on sagebrush in Wyoming.

At present there is no serious conflict between ponderosa pine management and grazing. In the Black Hills, thinned stands have shown an increase in forage production. What helped timber also seemed to help grazing. However, the forage use and value in thinned stands is questionable. On the Colorado plateau, pine type stands of lower density have been shown to produce more forage. A problem results from the tendency for increased intensity of pine management to increase average stand density and thereby reduce grazing capacity. Some physical data on this relationship are available for economic analysis (1,2).

Wildlife

The problems of wildlife use in conjunction with timber production are closely related to those of range use. How much wildlife can be supported in conjunction with different types and intensities of forest management? Such physical relationships are lacking in the study area. Another economic problem peculiar to wildlife use is that of determining the commercial, economic, and

other values of the forest wildlife resource in an area. Research in the economics of the wildlife resource on forest lands will have to await the development of an acceptable procedure for summing the widely different types of values that accrue as the result of the presence of wildlife.

Recreation

Here again, suitable measures of the value of the output of recreational use are lacking. In view of the increasing pressure of population upon the forest land for recreational use, studies are needed to determine the most economical methods of producing desirable types and amounts of recreation. At present there does not seem to be any possibility of directing a study toward the costs and benefits of recreational use in the station territory. Some work may be possible in conjunction with studies of other uses or in cooperation with state and other federal agencies.

Protection Problems

The annual mortality by cause for the station territory during 1952 is given in Table 8. The magnitude of these losses can best be comprehended by comparison with the annual cuts for the same year as shown in Tables 4 and 5. The losses by mortality for the area growing stock was almost 2 times the amount cut from it. The losses from live sawtimber stands were over 1.5 times the board foot cut (26). These tremendous losses are primarily the

Table 8 -- Annual mortality of live sawtimber and growing stock on commercial forest land by cause, 1952 1/

	High Mountains	Colorado Plateaus	Black Hills	Plains	Total Region
			Million cubic feet		
Growing Stock Mortality					
Fire	11	3/	3/	1	12
Insect	31	32	1	3/	64
Disease	22	5	3/	6	33
Other 2/	50	64	3	12	129
Total	114	101	4	19	238
			Million board feet		
Live Sawtimber Mortality					
Fire	59	2	4/	4	65
Insect	147	144	3	0	294
Disease	106	33	4/	23	162
Other 2/	262	212	12	24	510
Total	574	391	15	51	1,031

1/ Source: TRR, Vol. IX p. 32
2/ Weather, animals, suppression, etc.
3/ Less than 0.5 million cubic feet
4/ Less than 0.5 million board feet

result of the lack of utilization and the excess of old-growth stands. It can be noted that the losses in the Black Hills, where management is most intensive, amount to less than one-half as much as the annual cut. This is in direct contrast to the high mountains area where losses are over 2.5 times the cut. Similar comparisons can be made between net annual growth and mortality. These give even more emphasis to the fact that the protection problem is one of the lack of utilization rather than the lack of actual protection efforts. It should also be noted that the annual mortality in Table 8 is exclusive of catastrophic losses. In the high mountains these catastrophic losses have been extremely high in recent years due to the recently controlled Engelmann spruce insect epidemic.

The conclusion drawn from study of these conditions is that the best efforts are those directed toward more intensive management through increased utilization. The latter will be facilitated by economic studies in marketing and utilization. At this time, only brief mention needs to be made of the economic aspects of problems directly related to protection activities.

Fire Protection

The intensity of management and fire protection in the Black Hills, and in parts of Arizona and New Mexico, are such that studies to determine the proper level of investment and expenditure in fire protection in relation to losses from fire are warranted. It is generally understood that a program to reduce fire losses to zero

would be much more costly than the savings could justify. In certain areas studies could be based on the net savings in timber alone. In others, some account would have to be made of the losses in other values, such as range, water, game and recreation.

Insect Protection

Vaux in 1952 presented some economic considerations of the spruce beetle control in the Rocky Mountains (29). His analysis was based on the returns in terms of timber values, and on such a limited basis, concluded the control expenditures were not justified. However, he emphasized the need for measures of other values at risk and for joint study by land managers, pathologists, entomologists, and economists in order to develop a satisfactory economic evaluation of pest control problems. His analysis was made after the program was completed. The real need exists at the time of planning such programs. To be prepared in the future, measures should be taken to assign suitable values to all the uses of the forest land.

Disease Protection

Disease accounts for about 15 percent of the losses in volume of timber. Insect and disease losses combined are mostly the result of the unmanaged, over-mature condition of the stands. Forest administrators are faced with the problem of reducing these mortality losses on widespread areas by making salvage and

sanitation cuts. This type of cutting is costly because of the increased burden of the fixed costs per acre, such as roads. Information is needed on the savings in terms of increased growth through reduced mortality in order to make comparisons with the costs of such cutting methods. No such economic studies have been made. Pathologists, entomologists, and foresters should enlist the assistance of economics research in studies of salvage and sanitation cuttings in the near future.

FOREST INDUSTRY

The problems of forest-product harvesting and processing will be limited to the timber products of the forest. The problems are first viewed from the standpoint of wood products industries as a whole. Then they are viewed as problems of the operation of individual firms.

Harvesting and Processing Industries

Descriptions of the Industries are Needed

Information is lacking about the characteristics of the existing wood products industries in the station territory. Some work has been done by the division of forest utilization research in listing firms by broad size classes. However, very little is known about the general economic characteristics of the groups of firms that make up an industry. Much more needs to be determined

about the development of each industry, the industry's influence on the firms in it, the relation to the balance of the economy of the area, and the future outlook. This information is needed as essential background to facilitate an understanding of the problems of single firms. It is also useful in conjunction with forest survey data on forest resources and for studies of supply. The Colorado Agricultural Experiment Station has been studying wood products industries in Colorado (17). Similar data is needed for the other states of the area and for all wood products industries.

Production Response to Price

Marketing studies in Colorado have indicated that there seems to be a definite relationship between the market price for West Coast lumber and the price of locally produced lumber (16). An increase in West Coast prices has had a tendency to permit increases in local lumber price, which must, in turn, have some production influence. Similar situations may exist for other local wood-using industries. This aspect of industry is important in its relation to marketing studies. It should be studied first in a small area of relatively uniform conditions. Since lumber is the principal wood product and because the local lumber industry is characterized by small firms, initial study should be limited to lumber production. The lumber industry experiences considerable fluctuation in production and number of firms. This

type of study would help to better understand this and to plan a program for stabilizing the industry.

Competition Between Established Industries and New Ones

In the Black Hills efforts are being made to interest new industries in the use of the forest resource. Much interest has been shown in the development of a pulp industry in several parts of the station territory. This activity causes the existing industries to question the desirability of additional drain on the supply of standing timber. It has been noted that growth now exceeds drain and this in itself is justification for fostering new industry. However, as both existing and new industries develop, greater care must be exercised in fostering them. Public land administrators find themselves in the unenviable position of having to promote competition in order to obtain a fair market price for stumpage and at the same time having responsibilities for supporting stable communities. To carry out these two functions intelligently, more needs to be known about the economic and physical relationships between established and proposed new industries (19). Further mention of conditions related to this will be covered under the problems of individual firms.

Labor in Harvesting and Processing

One of the problems of the wood-using industries of the station territory is the seasonal nature of employment. In harvesting operations the seasonal nature of the work has made it necessary to employ relatively low quality labor. The seasonal operation also extends into mill operation. Even where operation is year-long the quality of labor seems to be relatively low. In many cases the labor is a transient type, unemployed ranch hands or miners. The real nature of this problem and its influence upon the functioning of the wood-using industries is not known. Exploratory studies are needed to reveal information on the type of skills needed, the number of such skilled workmen available, existing wage rates, methods of payment, and conditions of work. At present it is difficult to say whether the low quality labor is due to the nature of the industries or whether some of the undesirable characteristics of the industries is due to the low quality of labor. It is felt that the former is most nearly correct. Therefore, priorities will be given to studies on other phases of harvesting and processing industries, particularly on the economics of the operation of individual firms.

Harvesting and Processing Firms

Costs of Logging

There are two phases to the problems of logging costs in the central Rocky Mountains. The first phase is the result of the frequent indication that unit logging costs in the region are higher than those in other forested areas because of some inherent characteristics of the region and its timber. Studies which compare the costs of several areas must consider the differences in logging methods, in logging conditions, and in general efficiencies. Unit cost differences in logging could be analyzed to determine the influence of such differences upon the competitive position of firms in this region with those elsewhere. Some meager information has indicated that the high mountains area is at a disadvantage because of the high costs (29). Whether this is due to uncontrollable logging conditions or to other controllable factors, such as labor efficiency, is not known.

The second phase of logging cost problems can be based on the simple fact that logging costs make up the largest single cost item in lumber production regardless of the forest region. Therefore studies should be directed toward the determination of the most economical logging methods by making cost studies of them. The station is presently operating experimental logging equipment on steep slopes and otherwise inaccessible areas. Some studies have been made of the influence of logging conditions, but these are

limited to special circumstances. Boldt (4) studied the influence of special watershed harvesting limitations upon costs. Schaeffer (21) studied some costs of dead-spruce logging. Other studies of a limited scope have also been made.

Several secondary problems arise in cost studies. One of these is the problem of units of measure of the product. For example, the trees may be scaled using a volume table, the logs may be scaled by a log rule applied outside both barks at one stage of manufacture, inside at another and still differently at another, and, finally, lumber is cut and sold, on an actual lumber tally basis. Much work is needed on this measurement problem before cost studies can be effective. From the viewpoint of the economist, the real objective is to determine output in relation to both controllable and uncontrollable physical conditions on a time and cost basis. Time in man and machine hours is particularly important since labor and machine costs vary from time to time and place to place. Any information on logging costs by methods would be very useful to forest managers as well as to forest industry firms in the region.

Costs in Secondary Processing

The most important type of secondary processing at this stage of forest industry development in this region is sawmilling. Most of the timber sales are made to sawmill owners and operators. The appraiser must know the cost of efficient sawmilling.

Information on what type of operation produces efficiently, how, and at what cost would also be a great help to the firms themselves. At present the sawmills are predominantly the circular type. However, gang saws and band saws are gaining consideration and study could reveal their advantages and disadvantages from a time and cost standpoint. Several log-grade lumber-recovery studies are now being analyzed by the station. These contain information on sawing time in relation to log size and grade.

As processes for new industries are investigated and developed, emphasis will be placed upon the costs in order to estimate the level of profits. These problems will need to be covered by studies in cooperation with forest utilization. More on the conditions in the sawmill industry will be covered under lumber marketing because of their importance as a source of marketing problems.

The Marginal Log and Tree

If one changes viewpoint from that of forester to that of timber operator, the problem of financial maturity mentioned earlier in this analysis becomes a problem of the marginal log or tree. The two are directly related and have the most meaning when considered together. Operators in all parts of the station territory are faced everyday with the problem of deciding whether a certain tree or a certain log is economically acceptable for harvesting and manufacturing. Size is the usual characteristic on which decisions

are based. Sometimes there are some outward characteristics of quality that are valuable for judgment purposes. There is a very definite need for thorough study on this subject. Sawmills are known to use material smaller than what is usually considered smallest merchantable size. Is this because the marginal size is actually that small? Or is there shortage of raw material and a burden of overhead costs which force operators to cut all they can from a given number of trees? Can the large band-type sawmill afford to cut logs as small as those cut by smaller circular or gang sawmills? How does the quality or grade of the log influence the marginal size? How much defect can be permitted in a log before it should be abandoned in the woods? These are some of the questions that need answering. The forest utilization division has made some studies directed at other information but which lend themselves to analysis for purposes of determining the marginal log or tree. More work is needed in the area, particularly where the lumber industry has become well-established, as in the Black Hills and in Arizona.

Optimum Utilization of a Tree

The problem of the best use for a tree is closely related to that of the marginal tree. As competition for the use of the forest resource continues, information on the best use for each tree becomes more necessary. In Arizona, Southwest Lumber Company proposes to put in a pulp plant. Certain trees or logs will be

worth more when converted to pulp than to lumber. A problem will arise as to which these are. In lodgepole pine the value of poles now makes it worthwhile to select those trees suited and make them into poles rather than lumber. However, with changing pole and lumber market situations, the advantage of one over the other may change. If physical data were available on pole classes and lumber recovery from trees of various size and quality, changing values could easily be considered in deciding the best use. Similar problems will develop in the Black Hills between pulpwood and posts. Similar solutions will be needed.

Vertical Integration

One of the important processes in the growth of a regional economy from that of raw material supplier to one of industrialization is vertical integration. This process consists of the development and carrying out of additional operations by the same firm. Examples are the addition of a dry kiln and planer to a sawmill; the addition of a pressure cylinder to a pole peeling operation; the addition of a box plant to a sawmill, the addition of a prefabricated house operation to a sawmill; or the addition of a sales organization to a sawmill. More and more vertical integration takes place in the forest industry of this relatively undeveloped forest region each year. The future of the forest economy depends to a great extent upon the nature and amount of this vertical integration. It may result from new firms entering or from old firms

expanding. It may result in improved utilization of the raw material and increased profit to existing operations. Studies of vertical integration give valuable information needed on marketing.

Horizontal Integration

The combination of two or more firms, each engaged in the same stage of production, is called horizontal integration. One instance in this region is that in the Durango area where a large organization has purchased several small sawmills. The problem of optimum utilization of a tree is closely related to horizontal integration. The addition of a pulp mill to the Southwest Lumber Company sawmills will be horizontal integration. The profit, at least in part, will depend upon the possibilities for improved utilization of the raw material and more efficient processing. Information is needed to assist in stumpage appraisals for horizontally integrated firms. It would also be worthwhile in making estimates of future industrial developments in the region.

Overhead costs

Several conditions in the wood-using industries make it necessary for firms to be aware of the influence of overhead costs on operation and vice versa. Two important conditions in the station territory are small tree size and seasonal operation. The small average size of material in the sawmill means that a lot of log handling is done per unit of volume. Mechanization can speed

up handling operations but a problem arises due to the fact that most sawmill mechanization has been designed for large log operations. Cost studies are needed on small log-handling equipment.

The inability to operate during part of the year over most of the region tends to increase overhead costs. Investments in skilled labor, plant, and equipment must be amortized over short production periods. This places limitations on the types and amounts of investments. Studies are needed to facilitate making recommendations to firms considering investments and to provide an understanding of forest industry investment activity.

Product Diversification

An important limitation to the growth of this region's forest industry is the lack of product diversification. Englemann spruce produces only about five saleable grades of lumber and these are frequently reduced to one or two. Limited end uses are responsible for this condition. Lodgepole pine is similar in this characteristic, but has an advantage of being suitable for poles and posts. Ponderosa pine produces the most diverse products. However, the diversity in this region is less than other regions where more of the higher quality material can be recovered. For example, ponderosa pine lumber is used for sheathing, shelving boxes, pattern stock, sash and door stock, and many other purposes. Although this problem is principally one of marketing, an understanding of it is needed in directing

research activities toward new uses of species to make them more diverse and in promoting the development of more stable forest industries.

Technical Assistance to Small Firms

An important problem in the lumber industry of the region is that of the lack of technical "know-how" on the part of the operators. The logical and common approach to this problem is one of technical assistance in the form of sawmill clinics. These clinics may cover the subjects of marketing, saw maintenance, tax law, cost accounting, and so forth. However, the problem of the lack of technical knowledge may be secondary. The real problems may arise from the lack of equipment suitable for the timber, inadequate financial strength, poor markets, or just a generally uneconomic type of operation. The forest industry studies above are needed to determine the most important problems and guide any action for improvement. How effective a program of technical assistance might be will depend upon the exact nature of the factors that give rise to the problems.

MARKETING

Forestry, as the production of timber, is almost wholly dependent upon the process of marketing. Col. W. B. Greeley (13) wrote, "Sustained timber culture cannot be brought about on one-fourth of the soil of the United States, unless forestry in land use is backed up by forestry in marketing and economics. We cannot

grow what we cannot sell." Silvicultural practices receive application in the cutting or harvesting process which is the first step in the marketing process. The efficiency of the marketing process is a major factor in determining the economic practicability of forestry and forest-product consumption.

Marketing is principally buying and selling. However, the buying and selling is done several times before the final consumer is reached. Therefore, the transportation, storage, and sorting functions carried on during and between each sale form are included in a broad definition of marketing. In this program analysis the objective is to direct investigations of the marketing process toward those aspects of it which seem to be problems. A problem is any circumstance or set of circumstances whose continuance will result in a reduction in total net economic and social benefits. The approach will be primarily from a product viewpoint. First, there are some general marketing problems that influence the marketing of any wood product. Next, the problems associated with specific products will be discussed.

General Marketing Problems

Predominance of Public Timber Holdings

It has been pointed out that most of the forest land is publicly-owned. The most of the problems of marketing stumpage from public lands are associated with the buyer. These will be

covered later by discussions of the buyers problems. However, there are some problems from the public owner-seller standpoint. One of these is the size of sale in terms of volume. Large sales are easier to administer and frequently are better adapted to the timber management plan. Selling whole compartments at once reduces administrative costs and can make development (roads, etc.) easier and more economical. Numerous small sales result in higher administrative costs and conflicts between the several buyers. However, small enterprise is entitled to an opportunity to operate. In fact, the competition for standing timber may be greater when numerous small firms are in the market. This, in turn, may result in higher sale values for public timber. Public forest administrators are constantly faced with this problem of sale size and study is needed to determine the important factors to be considered.

Small Size of Private Timber Holdings

Although the average size of holding of private land in the region is much higher than other parts of U. S., the timbered areas and volumes are quite small. This tends to place the owner at a disadvantage in marketing his stumpage. Numerous studies have been made of the small seller's handicaps. Duerr listed several and a check of this list indicates that each is a problem in this region (9, pp. 186-193):

1. Seller's unfamiliarity with the market.
2. Seller's unfamiliarity with timber products.

3. Seller's handicap in harvesting and prepareing products.

4. Brief time devoted to timber marketing.

5. Prevalence of disadvantageous marketing methods, such as lump sum sale.

6. Seller's unfavorable financial position.

This private stumpage marketing is now the subject of study in many states, but Colorado is the only one being studied in the station territory. It is not necessary to elaborate further on this phase of marketing problems here.

Small Size of Timber Operators

The marketing of all wood products in the region is handicapped by the small size of the middleman. The post and pole cutters, sawmills, loggers, and pulp cutters are all involved in the earliest stages of marketing, i.e., stumpage buying. Their small size tends to make them inefficient market agencies. They cannot offer prices in keeping with the several types of end products that a stand may produce. They may have to pay cash or obtain costly financial assistance. They are not generally in a position to store, sort, and grade the products for resale to agencies beyond them in the marketing chain. They may be handicapped by the lack of knowledge of the markets for products other than the one each produces from timber. They may be unaware of the changes taking place in outside markets, although they generally know more about this than the small timber owners do. More will be said about this under specific

product headings.

The major part of the production of wood products is in the form of lumber in the station territory. The proportions of the various products are shown in Table 9. The products marketing will be discussed under lumber, poles and posts, pulpwood, and miscellaneous products.

Lumber Marketing Problems

Descriptions of the Products

Lumber is manufactured principally from Engelmann spruce, lodgepole pine, ponderosa pine, and Douglas-fir. Some aspen and true fir is also used. The Douglas-fir is used on the local market for heavy timbers and planking. The spruce and pine is made into boards and only rarely will a logging chance produce more than 10 percent of the volume in grades above the commons. Ponderosa pine in the Southwest gives the best grade yields, with the Black Hills ranking next. Lodgepole pine probably gives the poorest distribution of lumber grades and the least above common grade.

How much of the lumber is sold in a mill-run, rough-green condition and used locally is not known. The better operators produce a satisfactory product that seems to be able to compete with similar species and grades in the general market. However, it has been shown that the fact that it is "native" lumber has limited its acceptance. Part of this lack of acceptance has been

Table 9 -- Estimated production of primary wood products in region in percent of total, 1955 1/

Type of Product	Percent of Total Cubic Foot Production
Sawlogs	65.9
Fuelwood	27.5
Posts	4.0
Pulpwood	0.8
Veneer logs and bolts	0.7
Poles	0.7
Miscellaneous 2/	0.4
	100.0

Source: RM - Div. of Forest Economics, Survey of Industry, 1955.

1/ Includes products made from growing stock, dead and cull logs, and noncommercial forests.

2/ House logs, corral poles, excelsior bolts, ties, piling, mine timbers and props.

due to poor manufacturing and processing in the past. Part of it has been due to the producers inability to market effectively (16).

General construction accounts for most of the lumber use. The spruce and pine lumber is quite satisfactory where strength requirements are not high. There is a trend toward greater use in interior finish, particularly with knotty paneling. Ponderosa pine will yield a small amount of factory and shop lumber, but only the largest mills or concentration yards can saw and market it effectively. In order to be available for several possible uses and for different markets, the lumber must be graded. This is a job for skilled men who are expensive and scarce. Many of the problems of lumber marketing are directly related to the lack of satisfactory lumber grading.

Description of the Sawmills

The sawmill is the focal point of the local lumber market. Sawlogs are funneled into the sawmill for processing into lumber and there begins the process of distribution. In some instances there is further concentration beyond the sawmill. In addition to the important position it holds in the distribution system, there are other reasons for the sawmill being a key to marketing problems. The manner in which the mill processes the logs into lumber determines the type and quality of material that reaches the market. The ability of the sawmill to physically produce what the market demands is another important marketing factor. The costs, profits, labor, operating period, and efficiency of the sawmill operation

have great influence upon the market supply and price. Some of these were discussed under the heading of forest industry problems.

Table 10 lists the number of mills by type and capacity for the station territory. The outstanding characteristic of the industry is the predominance of small circular mills and of mills under 5 million board feet annual capacity. A great many of these mills are very small, producing less than 1 million board feet per year. Generally, these are small circular saws with only an edger and trim saw. They operate only part of the year and produce a rather low quality lumber. Most of these are portable or semi-permanent mills located in the woods.

The larger mills have planing and drying equipment and sell their material on the general market of the region and outside of the region. These larger firms are frequently owned and operated by retail and wholesale lumber dealer firms. They are permanently located in small towns. They store logs to provide them with a basis for year-long sawing. The lumber from these mills is graded by certified graders. This is in contrast to the small mills which generally sell on the mill-run, rough basis. Only one or two of the large mills own any substantial amount of timber land. The buyers of private timber are the smaller mills.

Although there is no real statistical basis, much evidence indicates that the typical small mill is inadequately equipped, underpowered, poorly operated, and just generally inefficient. The meaning of this ineffficiency in terms of cost of the productive

Table 10 -- Partial number of sawmills by type and capacity, 1955 1/

State	Total	Type of Mill			Capacity of Mill	
		Circular	Band	Gang	Under 5 MM	Over 5 M M
	number	number	number	number	number	number
Colorado	275	269	4	2	261	14
Wyoming	65	61	2	2	60	5
South Dakota	44	42	1	1	42	2
Nebraska	187	187	-	-	187	-
Kansas	no information available					
Arizona	61	56	5	-	56	5
New Mexico	150	147	2	1	148	2
West Texas	no information available					
Oklahoma	no information available					
Total	782	762	14	6	754	28

1/ Source: U. S. Forest Service, Forest Utilization Service, and State Extension Offices

process is not known. It can be shown that even an efficient sawmill is not an efficient user of capital, labor, and raw material. For example, losses in sawdust, slabs and edgings are a high proportion of the total wood volume used. At least part of the problem of production costs is associated with the methods used, irrespective of efficiency.

Concentration Yards

A growing phase of the lumber marketing process is that performed by the concentration yards. These are relatively new to the area. These firms buy rough lumber from many small sawmills. They remanufacture, season, grade, and store the lumber and maintain contacts with dealers and wholesalers. Sometimes these concentration yards are actually owned and operated by wholesale and retail yards. Thus far, the presence of these firms seems to be beneficial to both the small operator, the dealers, and users. They provide the stability, marketing experience, and volume necessary for more effective distribution to consumers and for more profitable operation of the small sawmills. Further development is needed in this market function if the small sawmill is to continue in existence.

There are several problems associated with the transactions between mill operators and concentration yards. Concentration yard specifications as to thickness and grading sometimes cause difficulty. With the advantage of knowledge of the finished product, its value, and its market, the yards are in a position to make the best of the

dealings with the small mill operator. The method of buying on a rough mill-run basis does not effectively stimulate quality production in the small sawmill. These are some problems that the otherwise beneficial concentration yard system creates and which need investigation.

Position of the Region in the General Market

Some of the lumber from the station territory enjoys a wide distribution outside of the region. A major part of the lumber industry developed as a result of the establishment of mills to supply the needs of eastern markets. Very few, if any, of the larger mills were established to supply the needs of the local region. The situation was such that local needs were supplied by small mills or by importing from other areas. The ownership of the larger mills by eastern retail yards precluded the possibility of any appreciable amount of the better quality local products reaching local markets. Most of this "exported" lumber went to the Omaha and Kansas City areas. Partly as a result of this situation in which small mills supplied the local needs, the local product developed a bad name on the markets within the region.

There is every reason to believe that the consumption on local markets of the type of lumber produced within the region is in excess of production. Yet about 15 to 20 percent of local production continues to be shipped to other regions and the transportation advantage is lost. In 1937 Steer reported that Colorado lumber

production was 83,991,000 board feet (23). For this same year Taylor and Hornibrook estimated the annual lumber requirements for the state to be 318,000,000 board feet, and added that approximately two-thirds of this volume was produced in other states (24). Merrick estimated in 1945 that of the total of 89,397,000 board feet of lumber produced in Colorado, 12,702,000 board feet were consumed in other states (18). Similar circumstances exist for other timbered states of the region. Eastern South Dakota, Kansas, and Nebraska are, of course, net importers because of the small forested areas and large populations.

No doubt the region will continue to enter into national lumber markets, particularly, in the plains states east to Chicago. This will depend on the continued operation and expansion of large mills and concentration yards owned by outside marketing interests. When considered from a forestry standpoint, the outside lumber markets are at least partially advantageous to the region since they stimulate better utilization of the sawlog resource. A possible disadvantage arises from the previously mentioned condition under which concentration yards buy rough mill-run material and fail to stimulate better quality manufacture on the part of the small mill.

It is necessary to understand the basis on which the lumber from the region is able to compete in the general market. Is it a somewhat inferior product receiving a low price because it is cheaper to transport to the market? Or is the cost of manufacture low due to low cost labor and low profit margin in the harvesting and processing

operations? The answers to questions such as these will help to determine the direction which studies of the small sawmill operation should take. The Colorado Agricultural Experiment Station is now studying these very questions.

Pole and Post Marketing

Lodgepole pine is the primary raw material for the pole and post industry of the region. About one-half of the lodgepole pine poles produced in the U. S. are produced in the station territory. Most of the poles and posts are treated with preservatives in the 10 pressure treating plants located in the region. The treated products are marketed through their sales agencies or consumed by the companies which own the treating plants. In the case of poles, the utility companies generally request bids to supply them with specified types of poles. The treated posts are generally sold to wholesale and retail lumber yards. The rough green poles and posts are supplied to the treating companies by contract loggers who cut them from public timber sale areas or from timber belonging to the treating companies.

There are two problems in marketing poles. One is the problem of competition between uses of lodgepole pine for poles and sawlogs. The other is the problem of acceptability of lodgepole poles in markets where southern pine, cedar, and other species are also available.

Pole and Sawlog Competition

Some stands of lodgepole pine contain more pole-quality trees than others do, but no stands contain very many. The general result is that, unless the logger is aware of them, the pole-quality trees are made into sawlogs. Under the prices that have existed in the past, there is a loss in net return if the better quality poles are cut into lumber. Data is needed to facilitate the determination of the most profitable use for these trees that can be made into either sawlogs or poles. These relationships could be used by timber seller as well as the buyer.

Lodgepole Pine in the General Pole Market

Most of the standards established for poles are as limiting on other species as they are on lodgepole pine. However, two specifications are particularly limiting to lodgepole pine. One is the specification for moist climates which sets the retention of preservative at a level higher than is easily attained in lodgepole due to its thin sapwood layer. The other specification is with regard to the amount of spiral grain permitted. Lodgepole pine has a high proportion of trees with spiral grain. However, any problem associated with the specifications cannot be attacked from a marketing research standpoint.

Pulp and Pulpwood

The pulpwood marketing system in the station territory is destined to change in the near future. At present the only pulp mill is a 25-ton kraft mill located at Flagstaff, Arizona. The material used there is taken from intermediate stands of ponderosa pine. The only other pulpwood marketing is the shipment of pulpwood from the insect-killed spruce areas near Glenwood Springs, Colorado, to the Lake States by one large company. There has been some other sporadic activity in the past but it involved rather small volumes shipped to the Lake States and to Texas. A change in the market is expected as a result of active planning for expansion of the Flagstaff kraft mill and for the construction of a newsprint mill at Newcastle, Colorado. There has also been an active interest in the possibilities for mills in the northern Black Hills and in Wyoming.

An important factor in the development of a pulp industry in the region is the population and industrial growth expected. It has been pointed out previously that this growth has been, and is expected to continue, above average for the nation. On this basis it is felt that the increasing local demands for paper and paper products will soon result in the development of a local pulp and paper industry. This is not taking into consideration the fact that there is an abundant supply of raw material available in dead spruce stands as well as in immature stands of spruce and other species.

The major problem in pulpwood marketing is the lack of such a market. It is a problem because there is a need for such a market in order to facilitate timber management. Fechner has indicated that in the northern Black Hills alone there is currently available 1,243,000 cords in intermediate stands (11, p. 7). This does not take growth into account. Further resource data are needed in the region. It seems apparent that the pulpwood cut in the region could be high even while the forests are being managed for sawtimber.

Miscellaneous Products

There are a number of miscellaneous wood products that can and are being produced in the region. Some of these warrant consideration by marketing research. The most important of these are mine timbers, mine ties, mine props, railroad ties, house logs, and excelsior bolts.

Mine Timbers, Ties, and Props

Mine timbers and ties are sawn products that were probably the mainstay of the earliest small mills of the region. These are now much less important products from the standpoint of volume of production. However, in some local areas they are important. The prime objective of the biggest sawmill in the Black Hills is the production of ties and timbers for a gold mine.

The mines needing ties and timbers generally request bids from sawmills to supply their needs. Sometimes a similar system

is used in obtaining mine props except these are not sawn and can be purchased from loggers. However, the common method in purchasing props is for the mine to quote a delivered price to the loggers. Observations have shown that the prop cutters are at the mercy of the mines under these circumstances. The importance of these marketing problems depend to a large extent upon the developments which take place in mining. There has been a continuing decline in that type of mining activity which uses mine props and timbers. Furthermore, there have been some recent developments in mining technique which tend to eliminate some of the uses of wood in mines.

Railroad Ties

Lodgepole pine and ponderosa pine are used for about 2 percent of the treated railroad ties in the U. S. Probably much less than one-half of these are from the region. Those ties produced in the region are treated at two or three plants. Only those mills near the treating plants can produce sawn-ties for the market. This is generally done on a contract basis with the price and quantity being quoted by the railroad or treating company on a yearly basis.

House Logs

The market for house logs is principally a local one. Sawmill operators sometimes contract to cut enough logs for a house for an individual. The demand is very seasonal. So far there has

only been a small number of house logs marketed on a regional basis. One speciality firm has operated with plants in New Mexico and Colorado but without any great success. The use of house logs is restricted to summer homes and seasonal tourist facilities at the present.

Excelsior Bolts

Aspen has been used for excelsior manufacture in Colorado and Arizona. The excelsior is used for fruit packing and for air-conditioner filters. Only small volumes are being used annually but the future may favor expansion of this use.

PROBLEMS OF CONSUMPTION OF FOREST PRODUCTS

The ultimate objective of forestry is the production of goods and services for the use of society. The ideal circumstance would exist if production was supplying the amount of forest products consumed and if the amount consumed was sufficient to provide the proper use of the growth from a timber management standpoint. In forest economics research, attention must be focused on consumption, present and prospective, in order to complete the picture of forest land use, production, and distribution. Any maladjustments in the patterns of consumption may imply that problems exist in the forest economy.

The first place to look for consumption problems is in the growth-drain relationships for the region. Table 4 and 5 have

already been referred to under forest management problems. These indicate that, broadly speaking, the forests of the region are being undercut. There are not enough data to analyze conditions that may exist in smaller areas and for specific products and species. Such data is needed and will be furnished by the forest survey which is now underway over part of the region. Undercutting makes it difficult to recognize any problems. Overcutting could indicate the existence of a problem the nature of which only more complete data would reveal.

In this region of general undercutting the main problem of consumption is the lack of it. More specifically, a higher consumption of products now available, as well as of those yet to be produced, is needed to make it possible for timber management to satisfactorily use and maintain forest land and growing stock. At several points in this analysis it has been emphasized that such increased consumption would help in the solution of technological problems. For example, increased consumption of pulpwood could do much to solve the problem of over-stocking in ponderosa pine by providing a market for thinnings.

The economic problems of growing, harvesting, and distributing the forest products of the region will necessarily receive the first attention of forest economics research. Undoubtedly increases in consumption will give rise to problems of overcutting in local areas and in certain species in the future and action will be required at that time. It is hoped that timber managers remain aware of these possibilities and thereby avoid the development of such problems.

A PROGRAM OF PROJECTS

BASIS FOR DETERMINING RELATIVE IMPORTANCE OF ECONOMIC PROBLEMS

Forest economics research at the Rocky Mountain Forest and Range Experiment Station is just now being given serious consideration. This is in keeping with the recent increases in activity in that portion of the regional economy based upon the forest resource. Several factors must be considered in determining at what point the whole body of interrelated economic problems should be attacked. The first, and probably most important, factor is the availability of manpower and funds. A second factor is the urgency of the need for solutions to the various problems. A third is the possibility of cooperation with other agencies, with Forest Service Administration, and with the other branches of research within the station.

The availability of manpower and funds is presently limited. Forest Survey activities are being carried out cooperatively with Region 2. One man is now assigned to marketing research in the station. This program of projects will be formulated on the basis of the present personnel.

The relative importance and urgency of economic problems has been discussed briefly in previous parts of this analysis. The program of projects to follow in this section will establish priorities for study based on urgency, as well as upon the other factors of personnel and possible cooperation.

Cooperation in economic studies is presently underway with three groups. The Colorado Agriculture Experiment Station is receiving station cooperation on two marketing projects. Region 2 is cooperating in the Forest Survey project for Colorado and Wyoming. The forest economist temporarily on duty to make this program analysis is cooperating with the division of forest utilization in analyzing the economic factors involved in three log-grade lumber-recovery studies. It is expected that cooperation will continue with all three groups.

THE PROBLEMS NOW BEING STUDIED

Forest Survey

The information being obtained by the Forest Survey in Colorado and Wyoming will be basic to most of the forest economics research planned for the future. The survey will undoubtedly be extended to cover the balance of the station area. Since much of the forest economics research will be directed toward the possibilities of increased industrial development of the timber resource, it is essential that its magnitude and potentialities be known. Forest Survey will obtain data on forest inventory, growth, mortality and cutting as a basis for such development.

Marketing

Forest products marketing studies are intended to improve present marketing practices and to extend the markets for the lower grade and unused wood resource. The Colorado Agricultural Experiment Station began marketing studies in the region in 1954 with a study of the demand for the so-called "native" lumber in Colorado. This first study revealed problems of local prejudice and emphasized the need for further marketing study. In 1955 a five-year project was started by Colorado directed at several problems in marketing forest products in Colorado. The first study under the project was a problem analysis which described marketing systems for various forest products (17). Another study under this project is now underway to discover the price relationships on the markets where Engelmann spruce and lodgepole pine lumber is being sold. In 1956 the Colorado Experiment Station began a study of private stumpage marketing in cooperation with 4 other western states (7). The staff of the Rocky Mountain Forest and Range Experiment Station has been cooperating in all of these studies.

Late in 1956 one man was assigned specifically to marketing on this station staff. A project analysis and work plan are now being prepared on pulpwood marketing in the stations territory. This study is urgently needed for two reasons. Industry is now inquiring about and investigating the possibilities of pulp manufacture at several places in the region. And, as has been pointed out earlier, timber management needs a greatly expanded pulpwood

market to make more intensive management of intermediate stands possible.

Log-Grade Lumber-Recovery

Log-grading studies have been made by forest utilization division in cooperation with Region 2 on ponderosa pine in the Black Hills (14), Engelmann spruce, and lodgepole pine. Although these studies were primarily to obtain lumber recovery data they are very helpful in solving timber-marketing problems. There is no log market in the region, but the development of log grades is basic to tree grades which are needed for the effective marketing of public and private stumpage. Additional studies are planned by forest utilization. Forest economics research should take advantage of this opportunity to assist in these studies.

These studies are valuable sources of information on the problems of the marginal log or tree, as well as on financial maturity and optimum stocking as guides to management. Analysis of the data collected so far needs to be completed soon in order to plan for more effective data collection on several new studies to be carried out in the Black Hills and Arizona during the summer of 1957.

The use of IBM machine computation procedures has made it possible to make more detailed analyses than are otherwise possible with the personnel and funds available. This method of data processing can be expanded in use in the future because Colorado State

University is securing facilities for a statistical laboratory and Region 2 of the Forest Service is obtaining accounting machines which will be partially available for research use.

Log-grade studies should be given immediate attention by forest economics research because of their importance in lumber marketing problems and because cooperation is readily available for data collection.

PROPOSED PROJECTS AND PRIORITIES

The most important problem in the region is the need for increased use of the forest resource in supplying the local, regional, and national needs for wood products. Therefore, all thoseprojects which will serve to increase utilization through better information regarding the resource, through extending markets, through developing new markets for residues and low-value species, and through more economical harvesting and processing will receive highest priority.

Another important group of problems are those associated with the need for information on costs and returns to guide forest management decisions in those areas where forest use is reaching higher intensities. Projects with these objectives will receive second priority.

The third important group of problems are those associated with the general problem of managing forest land for non-timber uses. Projects in this category will necessarily be involved in the evaluation of those uses and benefits not usually measured in economic terms.

These projects will be more or less long term in nature and will receive lowest priority. However, it should be kept in mind that the above priorities are principally determined by the manpower and funds. Additions in staff should be accompanied by a definite change in the priorities for proposed projects but not those now underway.

Projects Leading to Increased Use of the Forest Resource

These projects are proposed in addition to the studies now underway. It must be realized that the present studies may reveal other lines of study which are important and should be pursued before those listed here.

Survey of Wood Used on Farms and Ranches

This project should include the use of round as well as sawn wood products. There has been strong competition recently from steel and aluminum manufacturers in the market for fencing and general purpose construction on farms and ranches. This type of market was the one in which Lange found much of the local prejudice against "native" lumber to exist (16).

Influence of Building Codes and Regulations Upon the Use of Local Lumber Species

Very little is known about this influence other than scattered reports from urban centers in Colorado. This study could give valuable information without too much time and effort.

Costs of Lumber Manufacture in Various Types of Mills

There is a general belief that anything is better for making lumber than a small circular sawmill. Sash gang headsaws and various types of resaws are gaining favor. Guides toward lower-cost manufacturing methods are needed.

Influence of Overhead Costs on Small Mill Production Policies

Evidence collected to date indicates that the short operating season in most of the area and the burden of financing stumpage and fixed operating costs have tended to stimulate wasteful volume production without regard for quality (17). Further information is needed before positive action can be taken to correct this situation.

Costs of Logging in Difficult Terrain

The presence of a commercial quantity and quality of timber on an area does not mean that it can be economically harvested. This region is characterized by steep topography and few main transportation facilities. In order to evaluate the resource as a basis for industrial development it is necessary to know something of the influence of the terrain on which the resource is located on the costs of conversion. Furthermore, the success of new logging methods, such as the Wyssen system, will depend upon their cost with respect to existing methods.

Survey of the Use of Charcoal

The trend toward more outdoor-type living has resulted in an increased domestic consumption of charcoal. This may be an opportunity for increased use of residues and low value material in the region. Research has already begun in the physical and technological aspects of charcoal manufacture in the region.

The Marginal Log in Sawmill Operation

Utilization standards are now based principally on physical factors or previously out-dated relationships. Studies are needed to determine what smallest log size can be economically processed into lumber. These will also yield information on what proportion of defect can be permitted in a log. The data needed is usually available from log-grade studies.

Optimum Utilization of Pole-Quality Lodgepole Pine Trees

A study of the volume and value relationships for those lodgepole pine trees capable of being made into either poles or lumber would facilitate a wiser use of the resource as well as a better basis of timber appraisal. In some instances stands containing high quality poles are sold at sawlog prices and converted to lumber. In other cases pole operators cut these stands and fail to fully utilize the sawlog portions efficiently.

Construction Labor Costs as a Factor in the Use of Lumber for Sheathing

The use of wide sheets of fiberboard and plywood has been stimulated to a certain degree by the high cost of labor to put sheathing into place. An operator in the Black Hills finds that there is a $5 to $10 premium for wide boards of No. 3 common grade for sheathing. He is interested in the possibilities for edge-gluing narrow boards to make wide ones. A study of labor costs in sheathing residential houses would help to determine how much could be expended toward making wider boards and at which price narrower lumber can compete effectively with panels of fiber or plywood sheathing.

Economic Problems in Forest Land Management

Costs and Returns from Thinning in Ponderosa Pine

A study of this nature is needed in either the Black Hills or the Southwest, or both. There is information available on growth rates after various intensities and types of thinning that lend themselves to this kind of economic analysis. The amount of money now being spent and the large area needing attention justify early action on a study of this cost-returns relationship.

Financial Maturity and Optimum Stocking of Ponderosa Pine in the Black Hills

The log-grade studies of ponderosa pine are yielding information which can be used to improve the basis for the selection of the most profitable rotation and cutting cycle and for a marking guide. Specifically, this information will permit the determination of the conversion surplus in trees of various size. By combining this with data on the growth rate of these tree sizes, it is possible to choose those trees which are no longer increasing in value as fast as costs of growing are increasing. The addition of this economic criteria in the selection of trees to be harvested would greatly strengthen the case for sustained yield timber management.

Economics of Salvage and Sanitation Cutting

In the ponderosa pine of Arizona and New Mexico large areas must yet experience a first cut under management. Insect and disease continue to prevent appreciable net growth in these areas, even though there may be no epidemics. Light cutting to remove the infested, infected, and highly susceptible trees can cover large areas quickly, thereby hastening the conversion of the forest to a managed, vigorous growing condition. However, the costs of such light logging are high. Milling costs may also be high. Study is needed to determine how light a cut can be economically justified. Consideration must be given to the reduction

in mortality losses, the high fixed costs of light cutting, and the costs and returns of an alternative plan which cuts at a heavier per acre level but covers fewer acres each year.

Economics of Range Reseeding and Brush Clearing

As data becomes available on the effectiveness of range reclamation cost and returns, studies will be needed to help the range manager make a decision as to what positive action should be taken in the range problem areas. Consideration should be given now to the problem of what form and kind of data are needed to make such an economic analysis possible.

Costs of Regeneration in Spruce Beetle Epidemic Areas

Again, in this instance, technical information on the regeneration of desirable species may need to be combined with cost information to make decisions on what action can be taken on an area-wide basis. So far, there is only a small amount of information available on the success of regeneration methods.

Optimum Level of Fire Protection in the Black Hills

Fire protection in the Black Hills is credited with great accomplishments. Generally, it is believed that the expenditures are warranted in view of the values at stake. However, there is also reason to believe that an attempt should be made to correlate the level of expenditures with the reduction in losses. Expenditures

of this type can become excessive or inadequate as forest use-values change. By establishing now a firm basis of measuring the costs and benefits of the fire protection, decisions regarding the level of protection will be much sounder in the future and more easily made.

Problems of Measuring Multiple Use Benefits

Evaluation of a Watershed

By studying a more or less isolated forest area which is being used primarily for watershed purposes it may be possible to establish some methods of evaluating the benefits derived. There are several experimental watersheds in the station territory on which input-output data is being collected. As a beginning one of these can be used to make an economic analysis. A primary objective of such a study will be to establish methods of measurement of costs and benefits that lend themselves to analysis. The main difficulty will be associated with measuring benefits, although cost measurement can be equally difficult when it is in terms of a benefit denied from use.

The Demand for Recreational Facilities

The increases in recreational use of forest lands, particularly national forests, have been very great in the last 10 years. Before wise action can be taken to improve and increase recreational

facilities, basic information is needed on the type of recreation desired, where it is needed most, and the effectiveness of various methods of providing the desired types. The problem of financing and maintaining the facilities also needs investigation. A study of recreational demands in specific areas would be very helpful to national forest administrators.

BIBLIOGRAPHY

(1) Arnold, Joseph F.
1950 Changes in ponderosa pine bunchgrass ranges in northern Arizona resulting from pine regeneration and grazing. Jour. Forestry 48: 118-126, illus.

(2) _____
1953 Effect of heavy selection logging on the herbaceous vegetation in a ponderosa pine forest in northern Arizona. Jour. Forestry 51: 101-105, illus.

(3) Barr, George W.
1956 Recovering rainfall. Arizona State Land Department, Salt River Water Users Association, and University of Arizona, cooperating. 33 pp., illus.

(4) Boldt, Charles E.
1955 Final report on a study of the 1954 timber harvest operations on the Fool Creek Watershed. Master's thesis. Colorado A&M College. 62 pp., illus.

(5) Bowman, Isaiah
1911 Forest Physiography. New York. 759 pp., illus.

(6) Buell, Jesse H.
1954 Problems facing forest management in the central Rocky Mountains. Jour. Forestry 52: 163-165.

(7) Colorado Agricultural Experiment Station
1956 Price-determining factors and marketing practices for sawtimber stumpage of private timberland owners in Colorado. Unpublished project outline. 4 pp. [Processed]

(8) Dortignac, E. J.
1956 Watershed resource and problems of the Upper Rio Grande Basin. Rocky Mtn. Forest and Range Expt. Sta. 107 pp., illus.

(9) Duerr, W. A.
1949 The economic problems of forestry in the Appalachian region. Cambridge, Mass. 317 pp., illus.

(10) _____ and Vaux, Henry
1953 Research in the economics of forestry. Washington, D. C. 475 pp.

(11) Fechner, G. H.
1956 A survey of the pulpwood resource in the northern Black Hills. Rocky Mountain Forest and Range Expt. Sta., Sta. Paper 20, 21 pp., illus. [Processed]

(12) Fenneman, Nevin M.
1931 Physiography of western United States. New York. 534 pp., illus.

(13) Greeley, W. B.
1937 Forestry requires economics as well as silvics. Wash. [State] Univ. Forest Club. Quart. XI (1): 11-18.

(14) Kotok, E. S.
1956 Lumber recovery at a ponderosa pine sawmill in the Black Hills. Rocky Mountain Forest and Range Expt. Sta., Sta. Paper 19, 9 pp., illus. [Processed]

(15) _____ and Myers, C. W.
1955 An estimate of residues at a small sawmill in the Black Hills. Rocky Mountain Forest and Range Expt. Sta., Res. Note 17, 6 pp., illus.

(16) Lange, Robert W.
1955 A study of the demand for native lumber in Colorado. Master's thesis. Colorado A&M College. 79 pp., [Typed]

(17) McCain, Edwin A.
1956 A problem analysis of the marketing of forest products in Colorado. Master's thesis. Colorado A&M College. 67 pp. [Typed]

(18) Merrick, Gordon D.
1947 Distribution of lumber from sawmills in western states, 1945. U. S. Forest Serv., Div. of Forest Econ. 8 pp. [Processed]

(19) Newport, Carl A.
1956 A history of Black Hills forestry. S. Dak. Dept. of Game, Fish and Parks. 112 pp., illus. [Processed]

(20) Pearson, G. A.
1950 Management of ponderosa pine in the Southwest. U. S. Dept. Agr. Monog. 6. 218 pp., illus.

(21) Schaeffer, W. H.
1954 A harvesting technique for beetle-killed Engelmann spruce on the western slope of Colorado. Jour. Forestry 52: 861-862.

(22) Social Science Research Council, Subcommittee on Scope and Status of Research in Forest Economics
1936 A survey of research in forest economics. Social Sci. Res. Council Bul. 24. New York. 52 pp.

(23) Steer, Henry B.
1948 Lumber production in the United States, 1799-1946. U. S. Dept. Agr. Misc. Pub. 669, 233 pp.

(24) Taylor, R. F. and Hornibrook, E. M.
1937 The forest resources of Colorado. Rocky Mountain Forest and Range Expt. Sta. 21 pp., illus. [Processed]

(25) U. S. Forest Service
1956 Report of the Chief of the Forest Service, 1955. 27 pp.

(26) U. S. Forest Service
1955 Timber resource review, (preliminary review draft subject to revision). Washington, D. C.

(27) U. S. Department of Commerce
1954 Census of agriculture. Vol. 1, Parts 11, 12, 13, 29, and 30.

(28) U. S. Department of Commerce
1954 Census of manufactures. State Bulletins, MC-102, 105, 115, 126, 130, 140 and 149.

(29) Vaux, Henry J.
1954 Some economic implications of the spruce beetle control and salvage programs in Colorado. Jour. Forestry 52: 506-510.

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